COBURG
UNIVERSITY
of applied sciences and arts

MODUL HANDBOOK

Engineering Physics (B. Eng.)

Valid for study and examination regulations (SPO 2025)
02.06.2025

CONTENTS

1. PROFILE OF THE BACHELOR'S PROGRAM

If you're curious, love to experiment, and want to apply your knowledge in mathematics, physics, chemistry, and computer science to real-world challenges — this is the program for you.

What makes Engineering Physics in Coburg unique is the way we connect theory and practice. You won't just learn abstract concepts — you'll apply them directly in hands-on workshops, tackling practical problems by combining insights from physics, mathematics, and computer science to create smart, effective solutions.

Our goal is to give you the freedom to try new ideas, to succeed — and yes, sometimes to fail. Because that's how real learning happens.

The program prepares you to use physics and technology to tackle the technical and societal challenges of the 21st century. Along the way, you'll take part in regular hackathons where you can collaborate with your peers — or compete against them — and have fun putting your skills to the test.

2. MODULE STRUCTURE

Module Overview „Engineering Physics“

ECTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1W	Introduction to Advanced Mathematics					Scientific Basics					German Basics 1					German Basics 2							Soft Skills and Culture			Academic English Skills				
2S	Techn. Mathematics 1					Mechanics 1					Measurement Technology					Fundamentals in Electrical Engineering					Programming (Python)				German Basics 3				
3W	Techn. Mathematics 2					Mechanics 2					Optics					Applied Physics					Fundamentals in Computer-based Measurement Technology				Technical German				
4S	Techn. Mathematics 3					Mathematical Applications (Python)					Thermodynamics					Control Engineering					Engineering Design 1				Social Skills				
5W	Fluid Mechanics					Electrodynamics					Material Science					Advanced Solid State					Quantum Mech., Atomic Physics				Differential Equations and Integral Transform				
6S	Electives					Electives					Electives					Practice rel. Module					Laser				Scientific Work and Lab Workshops				
7W	Industrial Internship (or Inhouse Laboratory Projects)																									Internship Accompanying (Block) Seminars				
8S	Bachelor Thesis															Excursion					Engineering Project					Bachelor Colloquium				

3. MODULE DESCRIPTIONS

The following module descriptions are valid for the study and examination regulations SPO 2025. They will be updated before start of the term, if concept, content, or examination have been changed.

1 Introduction to Advanced Mathematics

(Engineering Physics, BEng, SPO 2025)

Summary	Higher mathematics includes arithmetic operations and analytical methods that go beyond the school basics. In addition to the number range of rational numbers, the range of real and complex numbers is also used. Special mathematical functions such as powers, roots, logarithms and angle functions are also required. When describing technical and scientific systems, different equations arise which require special solution algorithms depending on the type of possible non-linearity. Finally, the laws and formulas for plane figures and spatial solids as well as an understanding of the Cartesian coordinate system are also part of the foundations of advanced mathematics.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
1st term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	0.5
Workload	Overall workload: 150 hours, comprising ■ 45 hours online lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Numbering systems

- Calculating with rational numbers
- Percentages
- Real and complex numbers

Important real-value functions

- Potencies and roots
- Logarithms
- Sine and cosine, tangent

Basic equations

- The Linear and quadratic equation
- Fractional equations
- Root and exponential equations
- Triogonometric equations

Fundamentals of geometry

- Triangle theorems, similar triangles
- Area of plane shapes
- Surface area, body volume
- The Cartesian coordinate system

2 Scientific Basics

(Engineering Physics, BEng, SPO 2025)

Summary	Nature is described with the help of physical quantities. Their properties are observed and analyzed in experiments and relationships between the variables are investigated. An understanding of the structure of matter, its states of aggregation and changes in state and substance is fundamental to the interpretation of physical and chemical processes. In summary, Scientific Basics contains some fundamental features of our physical world view as well as an insight into the field of inorganic chemistry.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
1st term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	0.5
Workload	Overall workload: 150 hours, comprising ■ 45 hours online lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Physical quantities and their units

- The International System of Units
- Physical constants of nature
- Dealing with very small / large values, prefixes

Basics of experimentation

- Planning and conducting experiments
- Observation and data collection
- Evaluation, conclusion and documentation

The Structure of atoms

- Structure of atomic nuclei und nuclear reactions
- Bohr's atomic model
- Atomistic interpretation of physical effects

Chemical and physical bonding

- Energetically stable atoms and the octet rule
- Ionic and metallic bond
- Covalent bond (electron pair bond)
- The van der Waals interaction, hydrogen bond

The states of matter

- Solids, liquids, gases and plasma state
- The change of the aggregte state, phase diagrams
- Mixtures of substances
- Some selected physical properties of matter

Chemical reactions and stoichiometry

- Reaction equation, law of conservation of mass
- Exothermic and endothermic reactions

3 Academic English Skills

(Engineering Physics, BEng, SPO 2025)

Summary	The "Academic English Skills" module teaches the essential language and methodological skills for everyday academic life. It includes academic writing and reading, the targeted development of a subject-specific vocabulary and the improvement of grammatical and stylistic skills. In addition, oral communication skills, research techniques and critical thinking are trained so that students are optimally prepared for scientific challenges. The targeted language is at the CEFR B2 level.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
1st term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	0.25
Workload	Overall workload: 150 hours, comprising: ■ 60 hours online lecture ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

- Cultural awareness: recognition of cultural influences in the professional and academic environments.
- Academic and professional writing: techniques for correspondence, research reports and papers, as well as learning citation and referencing systems (e.g., APA, MLA).
- Academic reading: strategies for understanding and analysing scientific texts, critical reading and extracting relevant information from specialist literature.
- Critical thinking: methods for analyzing, evaluating and synthesizing information in order to develop one's own scientific arguments.
- Vocabulary and terminology: development of a subject-specific vocabulary and academic idioms.
- Grammar and style: development of grammatical structures and stylistic devices that are common in an academic context.
- Oral communication: techniques for holding academic presentations and participating in academic discussions.
- Listening comprehension: strategies for understanding lectures, seminars and academic discussions.

4 Soft Skills and Culture

(Engineering Physics, BEng, SPO 2025)

Summary	Trainings in soft skills and basic knowledge of German culture are essential for integration in local society and working culture.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
1st term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	3 ECTS
Factor towards degree grade	0.25
Workload	Overall workload: 90 hours, comprising ■ 20 hours online lecture ■ 40 hours self-study ■ 30 hours attended event (blocked in Coburg and surroundings)
Semester hour per week	2

CONTENT

Course content

Historical context from Middle Ages to Germany today:

Focus on German identity in the 21st century which will offer an understanding of German history, poli-tics, culture and society today.

- World War II and overview on German history after WW II
- The End of the Cold War: A New National Identity?
- Aspects of Modern German Life: Reunification and immigration
- Contemporary Challenges and Trends

Political system and its main consequences.

Cultural awareness and cross-cultural communications:

Understanding the German/European mindset.

Dealing with cultural differences and raising of culture awareness

- culture models, learning traditions, communication styles
- working together and the German work culture: intercultural communication in business, risks and opportunities in international teams and special features of intercultural cooperation

Culture shock

Some typical German customs.

Studying in Germany:

Understanding German Academic Culture

- Learning traditions: how to raise independent learning, conditions for successful learning

Excursions to the Coburg area and its neighbors.

5 German Basics 1 (Level A1)

(Engineering Physics, BEng, SPO 2025)

Summary	The German Basics 1 (Level 1) course is designed for international students with little or no previous knowledge of German. The aim is to build up basic knowledge that will enable students to participate for the communication in every day and academic scenarios (oral/written) from the start of the programme. The course content is tailored to the needs of the target group (e.g. internship). These are … ■ practice-oriented learning objectives (aligned by typical language/writing activities) ■ Basic vocabulary ■ Written communication: text type specific structures ■ Teaching learning strategies to enable autonomous learning ■ Use of authentic material The focus is on everyday communication in studies and work, (lexis and grammar follow this content (form follows content/function)

Language of instruction and examination	**Use in other programs**
German and English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
1st term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	0.25
Workload	
Semester hour per week	6

CONTENT

Course content

Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. Stu-dents can furthermore use language assistants, apps, online resources and similar tools to manage and expand their language learning.

Language Proficiency A1

Spoken interaction

- Can describe simple aspects of daily life in a sequence of simple sentences, using simple words and elementary phrases where preparation is possible.
- Can describe him/herself (name, age, family) usind simple words and formulaic expressions where preparation is possible.
- Can name an object (shape/colour) using elementary words and formulaic expressions where preparation is possible.

Reading Comprehension

- Can understand short texts on topics of personal interest (e.g. course announcements or stories on sport, music, travel) written in simple words and supported by illustrations and pictures.
- Can find and understand simple and important information in advertisements for special events, on handouts and in brochures (e.g. what is on offer, costs and prices, dates and places of events, departure times, etc.).
- Can understand short and simple messages (e.g. posts on social media or emails) suggesting when and where to meet.

Written production

- Can give information on matters of personal relevance (e.g. likes and dislikes, family, pets) using simple words/signs and elementary expressions.
- Can give basic personal information in writing (e.g. name, address, nationality), using the dictionary where appropriate.
- Can use very simple words/signs and phrases to describe certain everyday objects (for example, the colour of a car, whether it is big or small).

6 German Basics 2 (Level A2)

(Engineering Physics, BEng, SPO 2025)

Summary	The German Basics 2 (Level 2) course is designed for international students with elementary German language skills (Level A1). The aim is to enlarge their repertoire of linguistic and cultural competences that will enable students to participate in every day and academic scenarios (oral/written) and to identify and compare core aspects of German culture and society. The course content is tailored to the needs of the target group (e.g. internship). These are ... ■ practice-oriented learning objectives (aligned by typical language/writing activities) ■ Basic vocabulary ■ Written communication: text type specific structures ■ Teaching learning strategies to enable autonomous learning ■ Use of authentic material The focus is on everyday communication in studies and work, (lexis and grammar follow this content (form follows content/function)

Language of instruction and examination	**Use in other programs**
German and English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
1st term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	7 ECTS
Factor towards degree grade	0.25
Workload	
Semester hour per week	12

CONTENT

Course content

Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. Stu-dents can furthermore use language assistants, apps, online resources and similar tools to manage and expand their language learning.

Language Proficiency A2

Spoken interaction

- Can give a short, straightforward presentation on a familiar topic in own field with sufficient clarity to be followed with most effort, explaining the main points with sufficient precision.
- Can describe plans and arrangements, habits and daily activities and talk about past activities and personal experiences.
- Can report on aspects of own daily life, e.g. people, places, experiences in work and education.

Reading Comprehension

- Can understand very simple formal emails and letters (e.g. confirmations of bookings or online purchases) / Can understand short personal letters.
- Can find concrete, predictable information in simple everyday texts, e.g. advertisements, leaflets, menus, biblio-graphies and timetables.
- Can understand a short factual presentation or report on own field of interest provided it is written in simple language and does not contain unpredictable details.

Written production

- Can write in connected sentences about everyday aspects of own environment, such as people, places, a job or study experiences.
- Can write a series of simple sentences about own family, personal circumstances, educational background, current or previous occupation.
- Can write a very short, elementary description of events, past actions and personal experiences.

7 Technical Mathematics 1

(Engineering Physics, BEng, SPO 2025)

Summary	This course covers foundational tools needed to describe and analyze real-world engineering systems. Starting with set theory and complex numbers, the course builds toward understanding limits, calculus, and algebraic equations, all of which are essential for modeling change and solving dynamic problems. Topics like matrices, vector spaces, and linear systems allow for the structured analysis of multi-dimensional systems, forming the mathematical core for future studies in mechanics, control systems, and applied physics.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
2nd term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 contact hours ■ 90 hours self-study
Semester hour per week	6

CONTENT

Course content

- Set Theory
- Fundamentals of Complex Numbers
- Limits, Sequences, and Series
- Differential and Integral Calculus of Univariate Real-Valued Functions
- Matrices and Determinants
- Vector Spaces
- Linear Systems of Equations
- Algebraic Equations (up to Third Order)

8 Mechanics 1

(Engineering Physics, BEng, SPO 2025)

Summary	■ Students can reproduce the fundamentals of static equilibrium in rigid bodies. ■ Students can construct free-body diagrams of rigid bodies in both plane and space. ■ Students develop solution strategies for determining support and joint reactions, as well as for calculating internal forces in rigid bodies and systems of rigid bodies. ■ Students can determine the internal section forces of rods, torsion bars, and bending beams. ■ Students can calculate the stress states of rods, torsion bars regarding statically indeterminate problems. ■ Students can explain component stresses, principal stresses, and equivalent stresses (Maximum Principal Stress Theory (MPST), Maximum Shear Stress Theory (MSST) and Maximum Distortion Energy Theory (MDET)). ■ Students can characterize materials and develop the necessary procedure for a static strength verification.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
2nd term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

- Vector Calculus
- Force and moment equilibrium at a point, in rigid bodies, and in systems of rigid bodies
- Internal section forces
- Mechanical material properties / tensile test
- Strains
- Stresses / strength hypotheses

9 Fundamentals of Electrical Engineering

(Engineering Physics, BEng, SPO 2025)

Summary	The module covers fundamentals of electrical engineering, focusing on direct and alternating current circuits, including analysis methods and components. Key topics include electric and magnetic fields, field strength, voltage, potential, and capacitance. It also addresses material behavior in fields, electromagnetic induction, and energy and force calculations.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
2nd term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Direct current technology

- Simple electrical direct current circuits: Ohm's law, mesh-, node-, voltage- and current divider rules,
- Model of ideal and real linear voltage and current sources,
- Methods for calculating linear direct current networks: branch current-, mesh current- and node potential methods.

Alternating current technology

- Stationary sinusoidal alternating current in real representation,
- Linear two-pole alternating current technology: capacitors and coils,
- Simple circuits (series and parallel circuits) and oscillating circuits.

Electric field

- Introduction to the topics of electric charge, field strength, voltage, potential and capacitance,
- Calculation of electrostatic fields and potential fields for simple geometries,
- Matter in the electric field and polarization; energy and forces of the electric field,
- Fields of layered arrangements,
- Electric flow field.

Magnetic field

- Introduction to the static magnetic field in a vacuum: magnetic phenomena, Lorentz force and magnetic flux density, flow law and magnetic field strength,
- Magnetic field in matter: para-, dia- and ferromagnetism, permeability, simple magnetic circuits,
- Electromagnetic induction law: motion and rest induction, self-induction and mutual induction,
- Energy and forces of the magnetic field.

10 Programming

(Engineering Physics, BEng, SPO 2025)

Summary	

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
2nd term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT
Course content
Fundamentals of Programming with Python What is programming? Why Python? Setting up the development environment Variables, Data Types, and Expressions Variable assignment and core data types (int, float, str, bool) Type conversions and basic operations (arithmetic, comparison, logical) Control Structures Conditional statements: if, elif, else Loops: for, while, with break and continue Nested conditions and loops Basic Data Structures and Functions Lists and tuples: creation, access, modification Dictionaries and sets: key-value pairs, set operations Defining and calling functions Parameters, return values, scope of variables Files and Exceptions Reading/writing files, file modes Basic exception handling with try, except, finally Object-Oriented Programming Classes, objects, constructors Inheritance, polymorphism, method overriding Modules and Libraries Using and creating modules, working with packages (e.g. pip)

11 German Basics 3 (Level B1.1)

(Engineering Physics, BEng, SPO 2025)

Summary	The German Basics 3 (Level B1.1) course is designed for international students with basic German language skills (Level A2). The aim is to enlarge the repertoire of linguistic and cultural competences and to enable students to acquire study and work-related topics in oral and written communication, to be aware of cultural differences between their country of origin and Germany and to interact flexibly with culturally influenced forms of behaviour. The course content is tailored to the needs of the target group (e.g. internship). These are … ■ practice-oriented learning objectives (aligned by typical language/writing activities) ■ Basic vocabulary ■ Written communication: text type specific structures ■ Teaching learning strategies to enable autonomous learning ■ Use of authentic material The focus is on everyday communication in studies and work, (lexis and grammar follow this content (form follows content/function)

Language of instruction and examination	**Use in other programs**
German and English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
2nd term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	0.5
Workload	
Semester hour per week	4

CONTENT

Course content

Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. Stu-dents can furthermore use language assistants, apps, online resources and similar tools to manage and expand their language learning.

Language Proficiency B1.1

Spoken interaction

- Can give straightforward descriptions or reports on a range of familiar topics in own field of interest
- Can give short reasons or explanations for views, plans or actions.
- Can give a prepared, straightforward presentation on a familiar topic in own field in such a way that it can usually be followed with ease, explaining the main points with sufficient precision.

Reading Comprehension

- Can understand short texts on topics of personal interest (e.g. course announcements or stories on sport, music, travel) written in simple words and supported by illustrations and pictures.
- Can understand short and simple messages (e.g. posts on social media or emails) suggesting when and where to meet.
- Can read uncomplicated non-fiction texts on topics related to own interests and areas of expertise with pacifying understanding.

Written production

- Can produce straightforward, coherent text on a range of familiar topics within his/her field of interest, linking individual shorter passages in a linear sequence.
- Can write a very short, elementary description of events, past actions and personal experiences
- Can summarise, report and comment with some confidence on a wide range of factual information in his/her field, both on familiar routine matters and on less routine matters.

12 Measurement Technology

(Engineering Physics, BEng, SPO 2025)

Summary	When taking measurements, it is important to minimize the inevitable measurement error that occurs depending on the equipment used and its surroundings. The module Measurement Technology covers how measurement errors and uncertainties occur, how to quantify, minimize and handle them. This is done by going through the basic concepts of metrology and followed by addressing a range of measuring techniques and instruments with their characteristic behaviour. The combined lecture/exercise is accompanied by laboratory exercise to gain hands-on experience on the subject.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
2nd term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 hours lectures/lab ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

- Basic concepts of measurements:

units and standards, traceability, calculation of uncertainty, types of measurement errors, error propaga-tion, documentation

- Measuring Instruments:

Principle of measurement, structure/characteristics of analogue and digital multimeters, princi-ple/operation of analogue and digital oscilloscopes

- Sensors:

physical principles, common types, fabrication technologies, applications

- Methods for measurement of static and dynamic electrical quantities:

Current/voltage measurement, transient measurements, measurement range extension and measuring bridges, measurement of resistance and power, time and frequency, and other quantities

- Periodic Measurement Quantities

Averaging measured values from time diagrams, transformation to the frequency domain, representation of periodic measurement quantities as spectra, deriving characteristic values thereof and analysis of relationships between time and the spectrum

- Digital Measurement Technology

Sampling and amplitude quantization, quantization uncertainty, analogue/digital converters

- Practical Experiments

Application of the theoretical content, such as basic measurement methods and characteristics of peri-odic measurement signals

13 Technical Mathematics 2

(Engineering Physics, BEng, SPO 2025)

Summary	This course focuses on mathematical methods used to model and solve time-dependent and spatially varying systems in engineering. It begins with ordinary differential equations, both first-order and higher-order, which describe dynamic processes such as motion, growth, and decay. Systems of differential equations extend these ideas to coupled phenomena. With vector calculus, including multiple integrals and total differentials, students learn to analyze fields and spatial variations, which are essential in fluid dynamics, thermodynamics, and electromagnetics. The course also introduces partial differential equations for modeling wave motion, heat flow, and other distributed systems, along with numerical integration methods to approximate solutions where analytical ones are difficult or impossible. These tools are crucial for translating physical laws into solvable mathematical models in engineering and applied sciences.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
3rd term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 contact hours ■ 90 hours self-study
Semester hour per week	6

CONTENT

Course content

- First-Order Ordinary Differential Equations
- Higher-Order Linear Ordinary Differential Equations
- Vector Calculus (Multiple Integrals, Total Differential)
- Partial Differential Equations
- Systems of Linear Differential Equations
- Fundamentals of Numerical Integration

14 Mechanics 2

(Engineering Physics, BEng, SPO 2025)

Summary	Almost all classical machines have systems with moving components, which are typically modeled as mass points or rigid bodies. The mathematical description of motion processes is carried out using vectors in Cartesian or polar coordinates, for example. Newton's second axiom is used to analyze the effect of forces. The solution of the equation of motion formulated in this way, which is a differential equation for the position coordinate of the corresponding body, provides information about the temporal and spatial properties of a mechanical system. Finally, the methods based on Newton's second axiom can also be used to calculate special motion processes such as oscillations or impact processes.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
3rd term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Fundamentals of kinematics

Mathematical description of the movement of bodies

- Definition of velovity and acceleration
- Cartesian and polar Coordinates
- Linear and circular kinematics of the point
- Planar movements of rigid bodies
- Momentary pole, ideal rolling processes

Kinetics of the mass point

Analysis of motion processes with the mass point model

- The basic dynamic equation (second Newton's axiom)
- Free and guided movements with and without resistance forces
- Introduction to one-dimensional oscillations
- Momentum theorem and straight, central impact processes

Kinetics of the rigid body

Analysis of plane movements of rigid bodies

- Rotation around fixed axes
  - Definition of angular momentum
  - Torque set, the moment of inertia and Steiner's theorem
- The general plane movement, rolling processes

Definition of Work, Energy, Power

Meaning and simple formulas of these physical quantities

15 Technical German (Level B1.2)

(Engineering Physics, BEng, SPO 2025)

Summary	The Technical German (Level B1.2) course is designed for international students with independent German language skills (Level B1.1). The aim is to enlarge the repertoire of linguistic and cultural competences and to enable students to acquire study and work-related topics in oral and written communication, to be aware of cultural differences between their country of origin and Germany and to interact flexibly with culturally influenced forms of behaviour. The course content is tailored to the needs of the target group (e.g. internship). These are … ■ practice-oriented learning objectives (aligned by typical language/writing activities) ■ Basic vocabulary ■ Written communication: text type specific structures ■ Teaching learning strategies to enable autonomous learning ■ Use of authentic material The focus is on everyday communication in studies and work, (lexis and grammar follow this content (form follows content/function)

Language of instruction and examination	**Use in other programs**
German and English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
3rd term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	0.5
Workload	
Semester hour per week	4

CONTENT

Course content

Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life.

Language Proficiency B1.2

Spoken interaction

- I can talk about everyday topics or more specialised topics from my own subject domain in an understandable way and give an opinion.
- I can give and explain short, simple technical information, tasks or problems.
- I can present information and ideas in a comprehensible way and use simple arguments to support them.

Reading Comprehension

- I can understand the content of detailed instructions and assignments (e.g. the task of selecting specific information from a specialised text).
- I can take relevant information from short specialised texts for lectures and seminars.
- I can understand information for instruments and methods in my technical subject area when it is read repeatedly.

Written production

- I can take notes from basic articles or contributions on common specialised topics of general interest.
- I can write simple texts (e.g. descriptions of experiments) on everyday topics and on more specialised topics from my own subject domain.
- Can summarise, report and comment with some confidence on a wide range of factual information in his/her field, both on familiar routine matters and on less routine matters.

16 Optics

(Engineering Physics, BEng, SPO 2025)

Summary	Upon successful completion of this module, students will be able to: • Understand and apply the fundamental principles of geometrical and physical optics. • Analyze light propagation, reflection, refraction, and diffraction. • Describe and interpret interference and polarization phenomena. • Model and evaluate optical systems such as lenses, mirrors, and interferometers. • Understand modern applications of optics including lasers, fiber optics, and imaging systems.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
3rd term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours online lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

- Geometrical Optics: Ray optics, lens equation, optical aberrations, ABCD Matrix
- Wave Optics: Interference, diffraction, Huygens' principle
- Polarization: Linear and circular polarization, optical activity
- Fourier Optics: Diffraction patterns, Fraunhofer and Fresnel diffraction
- Gaussian Beams: Fundamental Gaussian mode, beam waist, Rayleigh range, propagation through optical systems
- Laser Physics: Basic principles, amplification, resonators
- Applications: Optical communication, microscopy, spectroscopy

17 Engineering Design 1

(Engineering Physics, BEng, SPO 2025)

Summary	The course teaches the basics of technical drawing and combines these with an introduction to design using CAD.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
4th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Design Content:

- Freehand Drawing
- Views, Projections, Sections
- Drawing Organization, Standards
- Dimensioning
- Representation of Standard Parts
- Surfaces
- Tolerances / Fits
- Geometric and Positional Tolerances
- Design Principles

CAD Content:

- Parametric Associative Modeling
- Sketch Creation
- Reference Elements
- Part Modeling
- Assemblies
- Drawings

18 Mathematical Applications

(Engineering Physics, BEng, SPO 2025)

Summary	Based on real-world data and case studies, this course teaches students to apply numerical methods, data analysis, and modeling tech-niques to solve practical engineering problems. Topics include numerical integration, solving differential equations, and large-scale linear systems, supported by Python-based computation. Students explore statistics, data visualization, PCA, and SVD to extract insights from complex datasets, while signal processing tools such as Fourier transforms and filtering techniques are used for analyzing dynamic signals. The course also covers optimization, machine learning fundamentals (classification, regression, clustering), and techniques for physical modeling, Monte Carlo simulation, and stochastic processes. Throughout the course, Python is used to build, simulate, and analyze mathematical models, culminating in a project-based application that integrates theory with practical problem-solving.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
4th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 contact hours ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Numerical Methods for

- Integration
- Solving Differential Equations (PDE, ODE)
- Solving Large-Scale Linear Systems

Statistics and Data Analysis

- Data Visualization
- PCA
- SVD

Signal Processing

- Fourier Transforms (DFT, FFT)
- FIR and IIR Filters
- Spectral Analysis

Optimization and Machine Learning

- Linear and Nonlinear Optimization
- Gradient-Based Methods
- Introduction to Machine Learning: Classification, Regression, Clustering

Modeling and Simulation

- Physical Modeling with Differential Equations
- Monte Carlo Methods
- Stochastic Simulations and Random Processes

19 Control Engineering

(Engineering Physics, BEng, SPO 2025)

Summary	In this module, basic competencies in linear systems modeling, analysis and controller design are acquired. Students will be able to describe systems and their characteristics in various domains, combine selected controllers and plants and design control-loops with respect to given performance requirements in time- and frequency domains.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
4th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 hours on-site and online lecture (alternating) ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

Systems modeling and analysis
System modeling and representation

- differential equations, transfer function, Nyquist-plot, Bode-diagram, state-space
- analysis of system characteristics
- linearization
- Closed-loop structure

Control plants
Typical controllers and plants

- P, I, D, PTn,PDT1

Stability
Analysis of systems stability

- BIBO and Lypubov-Stability
- Routh-Hurwitz criterion
- Lypunov’s direct method

Closed-loop control
Structures and performance criteria

- typical controller-plant combinations
- performance parameters
- controller design in time- and frequency domain

20 Thermodynamics

(Engineering Physics, BEng, SPO 2025)

Summary	This course provides a foundational introduction to engineering thermodynamics, focusing on the principles governing energy, heat, and work in mechanical systems. Students will learn to distinguish between system states and processes, analyze phase diagrams, and apply thermodynamic laws to both closed and open systems. Key topics include the behavior of ideal gases and gas mixtures, moist air, and steam; the first and second laws of thermodynamics; and the analysis of cyclic pro-cesses in power-adding and power extracting machines. The course also introduces selected adiabatic flow processes relevant to real-world engineering applications.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
4th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Students will be able to:

- Distinguish between:
  - State variables
  - Process variables
- Calculate:
  - Specific gas constants
  - State variables in the two-phase region
  - Properties of ideal gases and gas mixtures
  - Cyclic thermodynamic processes
- Understand and apply:
  - Phase diagrams
  - The first law of thermodynamics to closed and open systems
  - The second law of thermodynamics to various systems

Students will understand:

- Concepts of:
  - System and state
  - Processes and process variables
- Thermodynamic principles:
  - First law of thermodynamics
  - Second law of thermodynamics
- Behavior of:
  - Ideal gases and their state variables
  - Gas mixtures, moist air, and steam
- Analysis of:
  - Phase diagrams
  - Cyclic processes in power-generating and work-absorbing machines
  - Selected adiabatic flow processes

21 Fundamentals in Computer-based Measurement Technology

(Engineering Physics, BEng, SPO 2025)

Summary	Measurement technology is a fundamental prerequisite for conducting physical experiments, as well as for technological development and progress. Today, it is standard practice to collect measurement data digitally and via computer in order to process it further. In this module, you will get to know common sensors and learn how to condition their signals using appropriate measurement circuits so that they can be captured with the help of an analog-to-digital converter. You will also learn how to transfer the data to a PC and evaluate it there. In the lab, you will build the measurement circuits on your own breadboard, read various sensor signals using a microcontroller, and develop corresponding measurement programs on the PC.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
4th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 hours lectures/lab ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

Lecture:

- Introduction

Fundamentals of measurement technology, mechanical, electronic, and computer-based measurement, measurement chain

- Sensors

Detection of mechanical, thermodynamic, electromagnetic, and optical quantities

- Signal Conditioning

Conversion of measurement signals into voltage, amplification, adjustment of the meas-urement range

- Data Acquisition

Number systems in computing, sample & hold, DAC, ADC, measuring instruments, sam-pling theorem, windowing

- Interfaces & Protocols

Communication model, network topologies, RS-232, USB, GPIB, VISA, SCPI

- Data Processing

Digital filters, DFT

Lab:

The lab is based on individual experiment kits per student consisting of a prototype breadboard and a Raspberry Pi Pico microcontroller. The following topics are covered:

- Project Introduction

First MicroPython script, measurement with a photodiode

- Measurement of Small Voltages

Operational amplifiers, assembly of inverting and differential amplifiers, measurement of a thermocouple

- Measurement of Currents

Shunt resistor, transimpedance amplifier, measurement of a photodiode

- Measurement of Resistances

Building a Wheatstone bridge with an instrumentation amplifier, RTD, measurement of a strain gauge

- Building a Multimeter

Connecting an external 16-bit ADC, analog frontend for measuring voltage and current,

MicroPython script with command interpreter for communication with a PC, Python GUI

22 Technical Mathematics 3

(Engineering Physics, BEng, SPO 2025)

Summary	This course provides key mathematical tools for modeling and analyzing engineering systems, emphasizing transformations and advanced calculus. Topics include Laplace and Fourier methods for signal analysis, discrete and Z-transforms for digital systems, and advanced integration and differential equations for multi-dimensional and dynamic problems. These foundations support applications in control systems, physics, and computational engineering.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
4th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 contact hours ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

- Laplace Transform
- Fourier Series & Transform
- Discrete Fourier Transform
- Z-Transform
- Advanced Topics in Mathematics
    - Line Integrals, Multiple Integrals, Surface Integrals
    - Integral Theorems
    - Partial Differential Equations
    - Systems of Linear Differential Equations

23 Fluid Mechanics

(Engineering Physics, BEng, SPO 2025)

Summary	This introductory course in fluid mechanics covers the fundamental principles governing fluid behavior in engineering systems. Students will learn to analyze hydrostatic forces, apply the continuity and energy equations to pipe flows, and use the momentum conservation theorem to calculate forces and moments in fluid systems. The course also introduces key concepts of fluid kinematics, viscous flows, and distinguishes between laminar and turbulent regimes. Basic heat transfer by conduction is included to provide a foundation for thermal-fluid applications. Emphasis is placed on developing problem-solving skills for real-world engineering scenarios involving incompressible flow and heat transfer in pipes and other systems.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
5th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Students will be able to:

- Analyze hydrostatic systems:
  - Calculate pressure
  - Determine forces and moments
- Apply core fluid mechanics equations:
  - One-dimensional continuity equation for pipe flows
  - Steady and unsteady energy equation (Bernoulli equation)
  - Momentum conservation theorem to calculate forces and moments in pipe systems
- Evaluate thermal systems:
  - Calculate heat transfer by conduction in simple configurations

Students will understand:

- Fundamental fluid mechanics concepts:
  - Basic principles and hydrostatics
  - Fluid kinematics
  - Incompressible flows and streamline theory
- Governing equations:
  - Continuity equation
  - Energy equation (Bernoulli)
  - Momentum conservation theorem
- Flow behavior:
  - Fundamentals of viscous flows
  - Characteristics of laminar and turbulent flows
  - Pipe flow dynamics
- Heat transfer:
  - Basic conduction processes

24 Quantum Mechanics and Atomic Physics

(Engineering Physics, BEng, SPO 2025)

Summary	This lecture covers the essential concepts of quantum mechanics, providing students with the foundational understanding required to describe atomic and subatomic phenomena. Beginning with the hydrogen atom as a model system, students progressively explore more complex atoms with multiple electrons and their interactions in external fields. Additionally, the course addresses nucleons, nuclear models, and the mechanisms underlying nuclear radiation. Important experimental tools, such as particle detectors, are also discussed, linking theoretical principles with experimental practice. Altogether, this lecture provides a robust basis for analyzing and understanding physical systems at the quantum, atomic, and nuclear levels.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
5th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours online lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

After successfully completing this course, students will be able to:

- Describe and apply fundamental quantum mechanical concepts to analyze simple physical systems.
- Conduct and interpret basic experiments related to atomic and nuclear physics effectively and safely.
- Explain atomic structures and their connection to atomic spectra clearly.
- Demonstrate an understanding of nuclear structures, radioactive decay processes, and elementary nuclear reactions, along with recognizing their fundamental technological applications.

25 Technical Mathematics 4

(Engineering Physics, BEng, SPO 2025)

Summary	The Technical Mathematics 4 course equips students with advanced mathematical tools to solve physics-based problems. Emphasis is placed on integral transforms (such as Fourier transforms), higher-order and partial differential equations, and boundary value problems. Real-world applications include diffusion and wave equations, along with systems in cylindrical and spherical symmetry. Students will develop both competence in standard mathematical methods and awareness of their limitations. The course balances theory and practice through lectures, problem-solving, and multi-media teaching tools.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
5th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	8 ECTS
Factor towards degree grade	2
Workload	Overall workload: 240 hours, comprising ■ 90 hours lectures ■ 150 hours self-study
Semester hour per week	6

CONTENT

Course content

- Integral transforms (e. g. Laplace-Transform and Fourier transform)
- Numerical Methods and Series Formulas
- Higher order differential equations,
- Boundary value problems,
- Linear systems of ordinary differential equations, in particular with constant coefficients,
- Real world examples for Partial differential equations: diffusion equation, wave equation, partial differential equations with cylindrical and with spherical symmetry

26 Solid State Physics

(Engineering Physics, BEng, SPO 2025)

Summary	Our society is increasingly shaped by microelectronics and micro-sensors. The integrated circuit and the computers that make this possible are omnipresent. Quantum mechanics laid the theoretical foundation for this revolution at the beginning of the last century. In this lecture, starting from the macroscopic description, which is important for sensor technology, the way is taken into the microcosm of the solid state and the basic theories are dealt with, which allow us to understand what makes electronic components such as diodes and transistors possible. This study of the fundamentals of solid state physics is accompanied by experiments that include key experiments such as X-ray scattering or also covers electronic components such as the LED, the photodiode or thermocouples. This introduces students to the physical foundations of the microelectronic revolution.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
5th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 contact hours ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content
Solid state physics: crystal structures, band model, electrical conductivity; thermal, optical and magnetic properties and their theoretical description; introduction to quantum mechanics; diodes

27 Material Science

(Engineering Physics, BEng, SPO 2025)

Summary	All technical components consist of at least one material. Therefore, basic knowledge of materials science is essential for scientists and engineers. For example, it is important to understand how the internal structure of a material affects its properties. This course covers the relevant material groups for professional practice.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
5th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 contact hours ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

This course provides foundational knowledge to understand and address material-related questions in a technical work environment. Students will learn how to independently seek answers and solutions using various sources (textbooks, online resources, material datasheets, and experts). Key relationships and terminology in materials science are introduced to help students recognize and work with material aspects of technical products.

After an introduction to general concepts in material science and testing, the course covers the following material groups:

- Metals
- Polymers
- Surfaces
- Glass and ceramics
- Electronic materials

28 Electrodynamics

(Engineering Physics, BEng, SPO 2025)

Summary	Electric Fields: Charge, Coulomb's law, electric field strength and potential, Gauss's law, Poisson's and Laplace's equations, electric displacement density, capacitors, dielectrics, orientation polarization, ferroelectricity and piezoelectricity Magnetic Fields: Electric current, properties of magnetic fields, Ampère's circuital law, Biot–Savart law, magnetic flux, Lorentz force, mechanical effects in magnetic fields, Hall effect, behavior of matter in magnetic fields Electrical Conduction in Liquids and Gases: Electrolysis, Faraday's laws, accumulators, electrokinetic phenomena, non-self-sustained and self-sustained conduction in gases at low pressure Time-Varying Fields: Law of induction, inductance, Switching operations with capacitance and inductance, alternating current circuits, three-phase current Electromagnetic Waves and Radiation Physics: Wave equation, plane electromagnetic waves, energy density of electromagnetic waves, Poynting vector, blackbody and cavity radiation, Planck's radiation law

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
5th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 60 contact hours ■ 90 hours self-study
Semester hour per week	4

CONTENT

Course content

After successfully completing this course, students will be able to:

- Fundamental understanding of electrostatics and electrodynamics
- Ability to represent Maxwell's equations in both differential and integral form
- Competence in solving problems involving electric and magnetic fields under simplified boundary conditions
- Acquisition of foundational knowledge in electromagnetic waves, including an introduction to radiation laws
- Further development of skills in conducting, documenting, and analyzing experiments

29 Scientific Work and Lab Workshops

(Engineering Physics, BEng, SPO 2025)

Summary	Gaining scientific knowledge through experiments requires a structured way of working. First of all, it is necessary to deal with the relevant theoretical principles in sufficient detail. The experiment itself must be well planned and prepared. When carrying out the experiment, care must be taken to ensure constant framework conditions and precise recording. Finally, the measurements must then be evaluated in a scientifically correct manner and recorded together with the description of the experiment and the interpretation of the results in a factually compact documentation.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
6th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	-
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures and experiments ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

Basics of scientific work

- Information procurement and processing
- Planning and conducting experiments
- Evaluation and presentation of measurement data
- Structuring and design of a scientific report

Experiments from the following areas:

- Manufacturing processes
- Plastics processing
- Fluid technology
- Measurement technology

30 Elective Subject 1

(Engineering Physics, BEng, SPO 2025)

Summary	One module must be selected from a list of modules relating to mechanical engineering.

Language of instruction and examination	**Use in other programs**
English or German	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
6th term	Elective module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content
The contents of each module can be found in a separate description.

31 Elective Subject 2

(Engineering Physics, BEng, SPO 2025)

Summary	One module must be selected from a list of modules relating to mechanical engineering.

Language of instruction and examination	**Use in other programs**
English or German	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
6th term	Elective module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content
The contents of each module can be found in a separate description.

32 Elective Subject 3

(Engineering Physics, BEng, SPO 2025)

Summary	One module must be selected from a list of modules relating to mechanical engineering.

Language of instruction and examination	**Use in other programs**
English or German	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
6th term	Elective module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content
The contents of each module can be found in a separate description.

33 Applied Laser Technology

(Engineering Physics, BEng, SPO 2025)

Summary	Discover the fascinating world of lasers and their powerful applications in the Applied Laser Technology course. You'll explore how lasers shape industries—from high-precision material processing to cutting-edge medical treatments and advanced communication systems. Through hands-on experiments and real-world case studies, you'll gain practical experience and technical know-how. Learn about ultrashort laser pulses, nonlinear optics, and spectroscopy techniques that push the boundaries of modern technology. This course is perfect for those eager to combine physics, innovation, and impactful applications in one exciting module.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
6th term	Compulsory module	One term	Once a year in summer term

WORKLOAD

ECTS-Creadits	5 ECTS
Factor towards degree grade	2
Workload	Overall workload: 150 hours, comprising ■ 45 hours lectures ■ 105 hours self-study
Semester hour per week	4

CONTENT

Course content

1. Laser Beam Modification:
   - Mode locking for ultrashort pulses
   - Nonlinear optics and frequency multiplication
   - Optical components (e.g., polarizers, wave plates)
   - Methods of laser beam/pulse characterization
2. Industrial Material Processing:
   - Interaction of radiation with matter
   - Systems for laser ablation, drilling, marking, cutting, welding, soldering, surface treatment
   - Glass and plastic processing
3. Laser in Telecommunications:
   - Semiconductor laser selection
   - Modulation techniques
   - Fiber optic configurations
4. Laser Spectroscopy:
   - Absorption and fluorescence spectroscopy
   - Nonlinear and Raman spectroscopy
   - Time-resolved spectroscopy
5. Laser in Medicine:
   - Applications in dermatology, surgery, urology

34 Industrial Internship

(Engineering Physics, BEng, SPO 2025)

Summary	Practical semester in an industrial company

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
7th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	25 ECTS
Factor towards degree grade	The module is assessed as ‘pass’ or ‘fail’ and is therefore not included in the final grade.
Workload	20 weeks full time in a company
Semester hour per week	-

CONTENT

Course content
Application of theoretical knowledge to questions and topics in professional practice; the professional focus should be chosen according to the personal area of specialisation; possible areas are e.g. develo-pment, design, project planning, production, production preparation and control, quality management, optimisation of technical processes.

35 Industrial Internship accompanying Seminar 1

(Engineering Physics, BEng, SPO 2025)

Summary	The seminar deals with introduction to scientific work, organisation of literature research, ability to process information

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
7th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	3 ECTS
Factor towards degree grade	The module is assessed as ‘pass’ or ‘fail’ and is therefore not included in the final grade.
Workload	Overall workload: 112.5 hours, comprising ■ 37.5 hours classroom study ■ 75 hours self-study
Semester hour per week	3

CONTENT

Course content
Identification of topics and learning fields literature research, literature procurement, information preparation, presentations, practical report, Bachelor's thesis

36 Industrial Internship accompanying Seminar 2

(Engineering Physics, BEng, SPO 2025)

Summary	The seminar deals with project management: basic project management methods and their application, consistent planning and work on projects in a team, collaboration skills and working techniques, social skills.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
7th term	Compulsory module	One term	Once a year in winter term

WORKLOAD

ECTS-Creadits	2 ECTS
Factor towards degree grade	The module is assessed as ‘pass’ or ‘fail’ and is therefore not included in the final grade.
Workload	Overall workload: 75 hours, comprising ■ 22.5 hours classroom study ■ 52.5 hours self-study
Semester hour per week	2

CONTENT

Course content
From the idea to the clarified assignment, project influences, roles in project management, cooperation in projects, visions and goals, procedure and milestones, overview of all project tasks, planning and control-ling of projects, risk management, structure and preparation, classic PM and agile project management.

37 Engineering Project

(Engineering Physics, BEng, SPO 2025)

Summary	The practical engineering project serves as a supplement to the Bachelor's thesis. Specialist knowledge and scientific methods are deepened. Usually, a topic related or interlinked with the Bachelor's thesis is worked on in the relevant company.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
8th term	Compulsory module	One term	Each term

WORKLOAD

ECTS-Creadits	10 ECTS
Factor towards degree grade	2
Workload	Overall workload: 300 h (project work)
Semester hour per week	

CONTENT

Course content

- Project organization and structuring
- Literature research
- Methodical knowledge acquisition
- Scientific evaluation and documentation

38 Bachelor Colloquium

(Engineering Physics, BEng, SPO 2025)

Summary	In the Bachelor Colloquium, the motivation and the main results of the Bachelor thesis are summarized and presented. The presentation serves to defend your own work and answer questions from experts and the audience. This shows that you have understood the topic well and are able to explain and discuss it. You receive valuable feedback that can be used to improve your work or for future projects.

Language of instruction and examination	**Use in other programs**
English	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
8th term	Compulsory module	One term	Each term

WORKLOAD

ECTS-Creadits	3 ECTS
Factor towards degree grade	1
Workload	Overall workload: 90 hours
Semester hour per week	-

CONTENT

Course content

- Summary of engioneering and scientific results
- Designing and structuring a presentation, using suitable media
- Rhetoric in a professional context
- Discussion of scientific methods and expert knowledge

39 Bachelor Thesis

(Engineering Physics, BEng, SPO 2025)

Summary	As part of the Bachelor's thesis, students usually work on an engineering problem in a company. There are a wide range of topics to choose from in the areas of development, design, modeling and simulation, testing, production and logistics, etc. The project is accompanied and supervised by a member of staff and a professor at the university.

Language of instruction and examination	**Use in other programs**
English or German	BA Automation and Robotics BA Electrical Engineering for Sustainable and Renewable Energy BA Mechanical Engineering

Term	**Module category**	**Duration**	**Freq. of module offer**
8th term	Compulsory module	One term	Each term

WORKLOAD

ECTS-Creadits	12 ECTS
Factor towards degree grade	5
Workload	Overall workload: 360 hours (project work)
Semester hour per week	

CONTENT

Course content

- Project organization and structuring
- Literature research
- Methodical knowledge acquisition
- Scientific evaluation and documentation

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